REMARKS

This Amendment responds to the Office Action dated November 20, 2002 in which the Examiner rejected claims 7, 22, 39 and 48 under 35 U.S.C. §102(b), rejected claims 2 and 7 under 35 U.S.C. §102(e), rejected claims 3-5, 8, 12 and 40 under 35 U.S.C. §103, stated that claims 1, 16-20, 24 and 44-47 are allowed and objected to claims 9-11, 13-15, 23, 29-38, 41-43 and 49 as being dependent upon a rejected base claim but would be allowable if rewritten in independent form.

As indicated above claims 12, 22, 40 and 48 have been cancelled without prejudice. Therefore it is respectfully requested that the Examiner withdraws the rejection to these claims.

Claim 2 claims a photomask comprising a transparent substrate, a shade pattern and a phase shift pattern. The shade pattern is formed selectively on a main surface of the transparent substrate. The phase shift pattern is selectively formed on the shade pattern and the transparent substrate. The phase shift pattern has a surface planarized to a degree obtained by a chemical and mechanical polishing.

Through the structure of the claimed invention having a surface of the phase shift pattern planarized to a degree obtained by CMP, as claimed in claim 2, the claimed invention provides a photomask in which a phase shift pattern has a uniform thickness so that the contrast of the optical image is increased. The prior art does not show, teach or suggest a phase shift pattern which is planarized as claimed in claim 2.

Claim 5 claims a method of fabricating a photomask comprising the steps of forming a hollow section on a main surface of a transparent substrate. A shade pattern is formed in the hollow section. A phase shift pattern is selectively formed on the transparent substrate and the shade pattern. A slope shape is formed by chemical and mechanical pollishing on a surface of the phase shift pattern so that a thickness of a portion of the phase shift pattern in contact with the transparent substrate is gradually decreased.

Through the method of the claimed invention forming a slope shape by chemical and mechanical polishing on a surface of the phase shift pattern so that a thickness of a portion of the phase shift pattern gradually decreases, as claimed in claim 5, the claimed invention provides a photomask in which it is possible to increase the contrast of an optical image when semiconductor integrated circuits are fabricated. The prior art does not show, teach or suggest the invention as claimed in claim 5.

Claim 7 claims a photomask fabrication method in which a phase shift pattern is formed only by selective portions of the main surface of the transparent substrate.

Through the method of the claimed invention forming a phase shift pattern from a transparent substrate, as claimed in claim 7, the claimed invention provides a fabrication method of a photomask in which it is possible to increase the contrast of an optical image. The prior art does not show, teach or suggest forming a phase shift pattern in the substrate itself as claimed in claim 7.

Claims 7 and 39 were rejected under 35 U.S.C. §102(b) as being anticipated by *Hur et al* (U.S. Patent No. 5,437,947).

Hur et al appears to disclose in Fig. 7i a phase shift layer 28 and opaque layer 25 are used as a mask to form a groove 29 on both sides of trench 23. In Figure 9f, an opaque layer 25 is formed inside a transparent quartz substrate 21 within a trench and a phase shifting layer 28 is formed on top of the opaque layer 25.

Thus, *Hur et al* merely discloses in Fig. 7i an opaque layer 25 formed within a groove. Nothing in *Hur et al* shows, teaches or suggests a shade pattern which forms a same plane together with a main surface of a transparent substrate as claimed in claim 7. Rather, *Hur et al* disclose an opaque layer 25 formed within a groove below a main surface of the substrate 21.

Additionally, Hur et al discloses in Fig. 9f a phase shift layer formed on top of an opaque layer which is formed inside a substrate 21. Nothing in *Hur et al* shows, teaches a supports selectively etching a main surface of a transparent substrate to form a phase shift pattern as claimed in claim 7.

Since nothing in *Hur et al* shows, teaches or suggests selectively etching the main surface of the transparent substrate to form a phase shift pattern or a shade pattern which forms a same plane together with a main surface of a substrate as claimed in claim 7, it is respectfully requested that the Examiner withdraws the rejection to claim 7 under 35 U.S.C. §102(b).

Claim 39 recite additional features. It is respectfully submitted that claim 39 would not have been anticipated by *Hur et al* within the meaning of 35 U.S.C. §102(b) at least for

the reasons as set forth above. Therefore, it is respectfully requested that the Examiner withdraws the rejection to claim 39 under 35 U.S.C. §102(b).

Claims 2 and 7 were rejected under 35 U.S.C. §102(e) as being anticipated by *Lee* (U.S. Patent No. 5,824,439).

Lee '439 appears to disclose a substrate 31, a light shading layer 39 formed within a groove 37 formed in the substrate 31 and a phase shifting layer 41 formed so as to be in contact with the transparent substrate 31 at both sides of groove 37 and limiting the light-shading layer 39 to be within the groove 37.

Thus, *Lee '439* merely discloses a phase shifting layer 41. Nothing in *Lee '439* shows, teaches or suggests a phase shift film has a surface planarized to a degree obtained by a CMP as claimed in claim 2. Rather, *Lee* does not disclose specifically to what degree the phase shift layer 41 is planarized and never discloses that CMP is applied to the phase shift layer 41. Applicants respectfully submit that the process limitation of CMP itself limits the degree of planarization obtained as a result of applying the CMP process and thus is a structural feature.

Additionally, *Lee '439* merely discloses a phase shifting layer 41 formed on top of the transparent substrate 31 and on both sides of the groove 37 (see Figs. 4A-4D). Thus, nothing in *Lee '439* shows, teaches or suggests selectively etching a main surface of the transparent substrate to form a phase shift pattern as claimed in claim 7. Rather, *Lee '439* teaches away from the claimed invention since the substrate 31 of Lee '439 is only etched to form a groove which is filled with a light shading layer 39. Nowhere in *Lee '439* is the

substrate etched is form a phase shifting pattern (i.e. etching of the substrate 31 is not related to the formation of the phase shifting layer 41).

Since nothing in *Lee '439* shows, teaches or suggests a) a phase shift film has a surface planarized to a degree obtained by CMP as claimed in claim 2 or b) selectively etching a main surface of a transparent substrate to form a phase shift pattern as claimed in claim 7, it is respectfully requested that the Examiner withdraws the rejection to claims 2 and 7 under 35 U.S.C. §102(e).

Claims 3-5 and 8 were rejected under 35 U.S.C. §103 as being unpatentable over *Lee '439* in view of *Lee* (U.S. Patent No. 5,972,540).

Lee '439 merely discloses in Fig. 3 a phase shift layer 41 formed on a transparent substrate 31 overhanging both sides of a groove 37. Nothing in *Lee '439* shows, teaches or suggests a slope shape is formed by chemical and mechanical polishing a surface of the phase shift pattern so that a thickness of a portion of the phase shift pattern gradually decreases as claimed in claim 5. Rather, *Lee '439* merely discloses an evenly shaped phase shift layer 41.

Lee '540 appears to disclose in Figure 10d rectangular phase shifters 13a are heated and melted into semi-spherical or rounded phase shifters 21.

Thus nothing in *Lee '540* shows, teaches or suggests that a slope shape is formed by chemical and mechanical polishing as claimed in claim 5. Rather, *Lee '540* merely discloses that each phase shifter 13a is melted into a semi-spherical or rounded phase shifter 21.

Additionally, *Lee '540* merely discloses at Fig. 10f to flatten a top surface using CMP until a top portion of each semi-spherical phase shifter is polished-off. Nothing in *Lee' 540* shows, teaches or suggests forming a slope shape by chemical and mechanical polishing as claimed in claim 5. Rather *Lee '540* teaches away from the claimed invention and forms a flat surface.

Since nothing in *Lee '439* or *Lee '540* shows, teaches or suggests forming a slope shape by chemical and mechanical polishing a surface of a phase shift pattern so that a thickness of a portion of the phase shift pattern gradually decreases as claimed in claim 5, it is respectfully requested that the Examiner withdraws the rejection to claim 5 under 35 U.S.C. §103.

Claims 3, 4 and 8 recite additional features. It is respectfully submitted that claims 3, 4 and 8 would not have been obvious within the meaning of 35 U.S.C. §103 over *Lee '439* and *Lee '540* at least for the reasons as set forth above. Therefore, it is respectfully requested that the Examiner withdraws the rejection to claims 3, 4 and 8 under 35 U.S.C. §103.

Claim 8 was rejected under 35 U.S.C. §103 as being unpatentable over *Hur et al* in view of *Lee '540*.

As indicated above, since the primary references do not show, teach or suggest the primary features as discussed above, it is respectfully submitted that the combination of the primary references with the secondary references would not overcome the deficiencies of

the primary references. Therefore, it is respectfully requested that the Examiner withdraws the rejection to claim 8 under 35 U.S.C. §103.

Since objected to claims 9-11, 13-15, 29-38, and 49 depend from allowable claims and since objected to claim 23 and 41-43 have been rewritten into independent form, it is respectfully requested that the Examiner withdraws the objection thereto.

New claims 50-51 have been added. It is respectfully submitted that these claims are also in condition for allowance.

Since claims 25-26, which are withdrawn, depend from allowable claims, it is respectfully requested that the Examiner allow these claims.

Thus it now appears that the application is in condition for reconsideration and allowance. Reconsideration and allowance at an early date are respectfully requested.

If for any reason the Examiner feels that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed within the currently set shortened statutory period, applicant respectfully petitions for an appropriate extension of time. The fees for such extension of time may be charged to our Deposit Account No. 02-4800.

In the event that any additional fees are due with this paper, please charge our Deposit Account No. 02-4800.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: _____
Ellen Marcie Emas
Registration No. 32,131

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

Date: May 20, 2003

Marked-up Claims 2, 5, 7, 23, 31, 32, 36, 37, and 41-43

2. (Twice Amended) A photomask comprising:

a transparent substrate;

a shade pattern formed selectively on a main surface of said transparent substrate; and

a phase shift pattern selectively formed on said shade pattern and said transparent substrate,

wherein [a surface of] said phase shift pattern [is] has a surface planarized to a degree obtained by a chemical and mechanical polishing.

5. (Twice Amended) A method of fabricating a photomask comprising the steps of:

[a transparent substrate;]

forming a hollow section [formed] on a main surface of [said] a transparent substrate;

forming a shade pattern [formed] in said hollow section;

selectively forming a phase shift pattern [selectively formed] on said transparent substrate and said shade pattern[,]; and

[wherein] forming, by chemical and mechanical polishing, a slope shape on a surface of said phase shift pattern so that a thickness of [an end section] a portion of said

Marked-up Claims 2, 5, 7, 23, 31, 32, 36, 37, and 41-43

phase shift pattern in contact with said transparent substrate gradually decreases[, the gradual decrease formed by chemical and mechanical polishing].

7. (Twice Amended) A method of fabricating a photomask comprising the steps of:

[a transparent substrate;]

forming a hollow section [formed] on a main surface of [said] a transparent substrate;

forming a shade pattern [formed] in said hollow section, said shade pattern having a surface which is not in contact with said transparent substrate and forming a same plane together with the main surface of the transparent substrate; and

[a phase shift pattern formed by] selectively etching said main surface of said transparent substrate to form a phase shift pattern after forming said shade pattern.

23. (Twice Amended) A photomask fabrication method at least comprising the steps of:

forming a resist on a transparent substrate;

forming a pattern by selectively exposing and developing said resist by using a radiation ray;

Marked-up Claims 2, 5, 7, 23, 31, 32, 36, 37, and 41-43

selectively etching said transparent substrate by using said resist as a mask;

eliminating said resist;

forming a shade film on said transparent substrate which is selectively etched;

performing a chemical and mechanical polishing for said shade film;

forming a resist film on said shade film;

selectively etching said resist film;

selectively etching said transparent substrate; and [according to claim 22, after the step of selectively etching said transparent substrate, further comprises the step of:]

performing said chemical and mechanical polishing for a phase shift pattern formed by selectively etching said transparent substrate.

31. (Amended) [A] The method of fabricating a photomask according to claim 5, wherein said phase shift pattern includes a phase shift pattern formed every other opening on the photomask.

32. (Amended) [A] The method of fabricating a photomask according to claim 7, wherein said phase shift pattern includes a phase shift pattern formed every other opening on the photomask.

Marked-up Claims 2, 5, 7, 23, 31, 32, 36, 37, and 41-43

36. (Amended) [A] The method of fabricating a photomask according to claim 5, wherein said phase shift pattern includes a phase shift pattern having an auxiliary opening with a shifter which is not resolved adjacent to a main opening.

37. (Amended) [A] The method of fabricating a photomask according to claim 7, wherein said phase shift pattern includes a phase shift pattern having an auxiliary opening with a shifter which is not resolved adjacent to a main opening.

41. (Amended) A photomask [according to claim 7, further including] comprising:

a transparent substrate;

a hollow section formed on a main surface of said transparent substrate;

a shade pattern formed in said hollow section;

a phase shift pattern formed by selectively etching said transparent substrate; and

a halftone phase shift pattern with a shade pattern.

42. (Amended) A photomask [according to claim 7, wherein said phase shift pattern has] comprising:

a transparent substrate;

a hollow section formed on a main surface of said transparent substrate;

Marked-up Claims 2, 5, 7, 23, 31, 32, 36, 37, and 41-43

a shade pattern formed in said hollow section; and

a phase shift pattern formed by selectively etching said transparent substrate, and having a shade pattern formed with a phase shifter.

43. (Amended) A photomask [according to claim 7, further including] comprising:

a transparent substrate;

a hollow section formed on a main surface of said transparent substrate;

a shade pattern formed in said hollow section;

a phase shift pattern formed by selectively etching said transparent substrate; and

an intermediate type phase shift pattern.